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THREE YEARS OF BROADCAST SPRAYING CHAMISE SPROUTS IN SOUTHERN CALIFORNIA

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ABSTRACT: In a 3-year study, low volume, broadcast applications of 2,4-D gave effective control of chamise regrowth on fuel-break sites, but two applications in consecutive years were necessary in most cases. This paper reports the effects of rate, volume, and timing of chemical application; the influence of plant coverage, chemical formulation, and annual growing conditions; and the cost of spraying.

Wildfire in southern California during 1961 spotlighted once again the vital need for better fire control techniques for the brushlands of this area. Here severe burning conditions exist much of the year, and heavy fuels occur in continuous expanses on steep terrain, much of it inaccessible. Improvement of this situation was the goal of the firefighting agencies in southern California when they organized the Fuel-Break program in 1957.1/

This new approach consists of breaking up extensive brushfields at strategic locations with wide strips or blocks--called fuel-breaks--having a new permanent grass cover classed as light fuel. This required removal of most of the native shrubs on the fuel-break sites and prevention of their regrowth. The task can be difficult and expensive since most brush species are hard to eradicate. They recover quickly after clearing by fire or other means, either as root crown sprouts from the mother plants or as seedlings.

1/ FUEL-BREAK is a cooperative fire-control program of the California State Division of Forestry, Los Angeles County Fire Department, and U.S. Forest Service.

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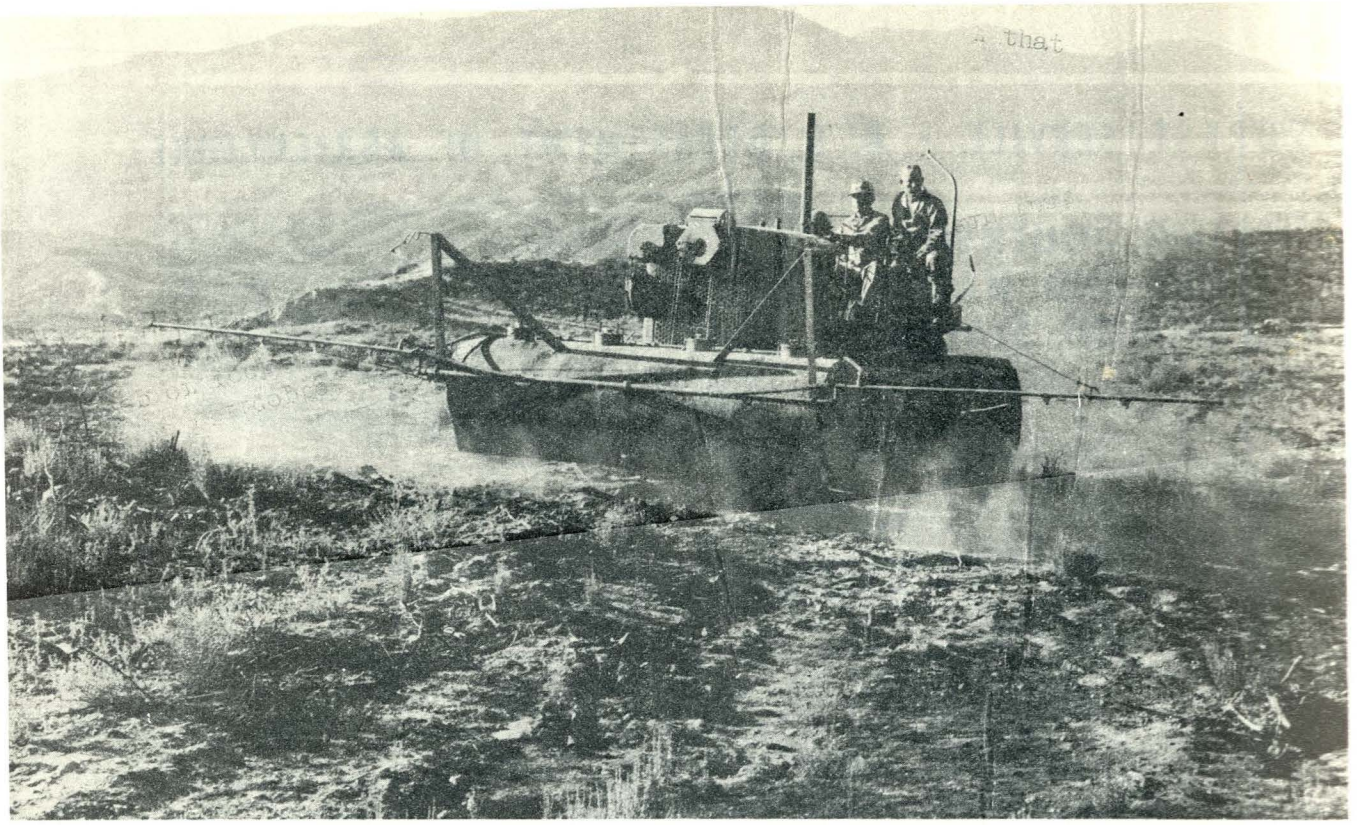

Figure 1.--A D-7 tractor mounted with a 300-gallon slip-on spray unit effectively sprays resprouting chamise on moderate slopes.

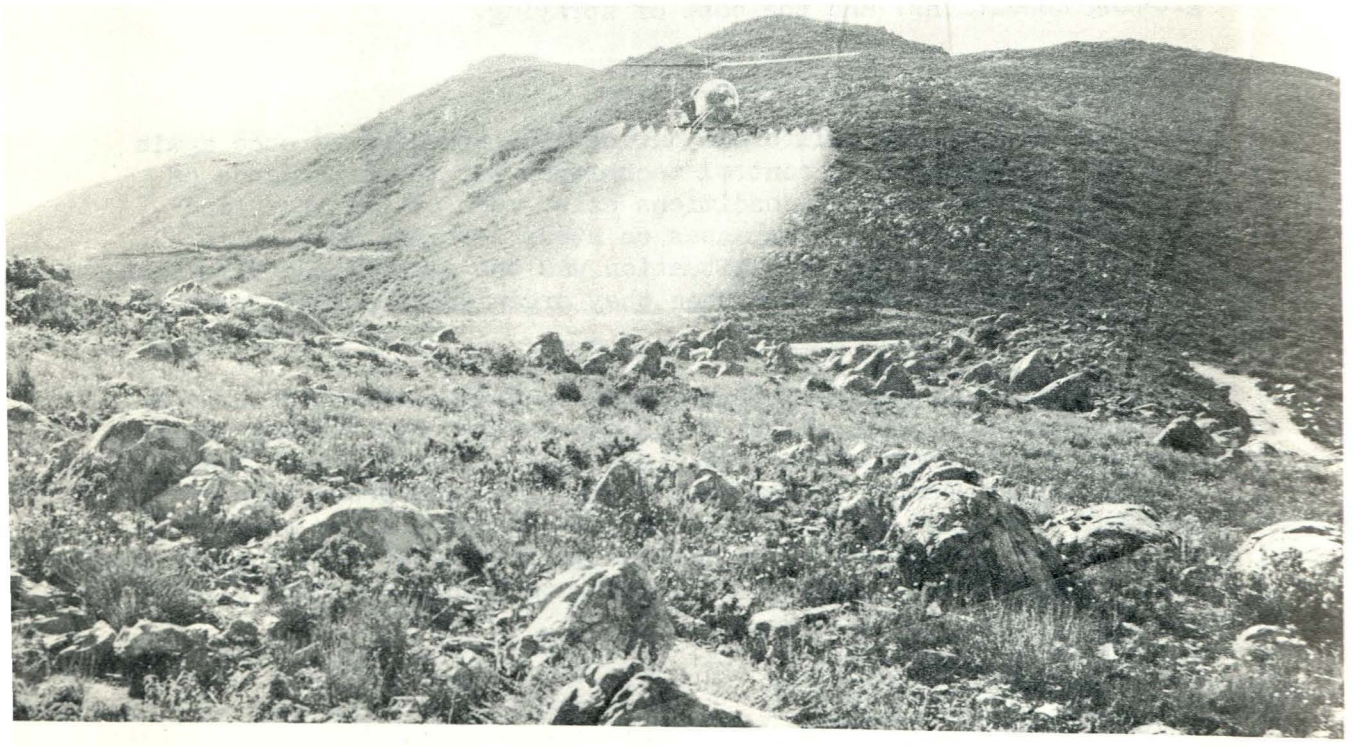

Figure 2.--A helicopter is often used to spray fuel-break terrain that is steep or rocky.

Chamise (Adenostoma fasciculatum) is one of the most common components of the chaparral. It presents a major reclearing problem since it resprouts vigorously after top removal. Hand grubbing or mechanical methods of plant control are not adequate for large acreages or rough terrain such as dealt with on fuel-breaks. Eliminating all woody plants by these methods is usually either impossible or impractical. A few plants are almost always missed; continued reclearing or maintenance is necessary and often requires all available manpower. Complete eradication of the unwanted plants by chemical treatment is a practical way of eliminating a gigantic maintenance problem so that urgently needed new breaks can be constructed.

Plant control work prior to 1959 by Leonard (1956, 1957) and others indicated that low volume, broadcast applications of hormone herbicides would kill 1- and 2-year-old chamise sprouts. To date, low volatile esters of 2,4-D have been the most effective and economical materials available for chamise control. An important characteristic of 2,4-D is its selective action on broadleaved plants which make it possible to establish a grass cover for soil protection yet weed out unwanted plants.

This report describes methods used to broadcast-spray chamise sprouts on fuel-breaks in southern California and presents results obtained during the first 3 years, 1958, 1959, and 1960.

Fourteen areas totaling about 800 acres were sprayed for chamise control (table 1). About 500 acres of mixed chaparral containing various amounts of chamise were also treated.

METHODS OF CHEMICAL APPLICATION

A broadcast spray application--a given amount of chemical uniformly sprayed on a given unit of area--is a low-volume treatment, usually with 20 gallons or less of chemical mix applied per acre. The chemical can be applied either from the ground with a tractor-mounted sprayer or from the air with either a plane or helicopter. Both methods are used on fuel-breaks.

Tractor Spraying

The initial work in 1958 was done with a 15-horsepower Cletrac tractor outfitted with a 20-foot spray boom. Although it had been used on hundreds of acres of chamise, this equipment could not operate safely on rough, rocky fuel-break terrain. Larger equipment was needed to safely cover more terrain in less time and with fewer breakdowns.

During the winter of 1958-59, a 300-gallon spray unit was developed to slip on a D-7 tractor in place of the dozer blade (fig. 1). It carried a pump system and 25-foot spray boom. This big equipment greatly increased the scope of tractor spraying. On smooth slopes with less than 40 percent gradient, this unit treated 6 to 8 acres per hour. But area sprayed decreased on rough or rocky terrain and on areas poorly cleared of brush.

Helicopter Spraying

On steep, rocky areas where a tractor could not be used efficiently, we turned to aerial application. A model G, Bell helicopter served for most of our work (fig. 2). On the average the ship carried about 50 gallons per load. A standard volume of 20 gallons per acre of chemical mix was applied to insure thorough coverage, each area was double flown each time at 10 gallons per acre. Under favorable conditions, 25 to 30 acres were double flown per hour.

RESULTS

Three year's experience in spraying chamise regrowth on 14 projects has shown that broadcast chemical spraying, either by tractor boom or helicopter, was effective. On three fuel-break projects a single application of 2,4-D killed 95 percent or more of the brush sprouts and seedlings. The remaining plants were easily killed by hand spraying. On the 11 other projects, a second broadcast application was needed. On these areas, the first application killed 50 to 80 percent of the sprouting chamise plants and usually all of the brush seedlings. We rated this degree of control "poor," because too many living sprouts remained for efficient hand spray follow-up. We required 95 to 99 percent total kill for a rating of "good." These were high standards, but areas with less than a "good" kill generally required follow-up broadcast spraying.

Numerous factors must be considered in evaluating a chemical spray program. Some of these are: (a) rate, (b) volume, (c) timing, (d) annual growing conditions, (e) coverage, (f) chemical, and (g) cost of application.

Rate of Chemical Application

Early work indicated that 2 to 3 pounds, acid equivalent, of 2,4-D per acre gave satisfactory control of chamise sprouts under ideal conditions (Leonard, 1956). At the start of the Fuel-Break program, we increased the rate of chemical from 2 to 4 pounds, acid equivalent (a.e.), per acre for tractor work. We did this for several reasons:

1. Spraying could not always be done under ideal conditions.
2. We found in an earlier test in central California that a 2- to 3-pound rate killed fewer large chamise sprouts than higher rates (Plumb and Bentley, 1960).
3. The cost of 2,4-D was relatively low--an extra one or two pounds appeared to be a good investment, especially since operational costs were high.

So far we have no consistent results indicating that less than 4 pounds per acre should be applied for a high kill from a single application. A 1959 study indicated that 8 pounds were not much more effective than 4 pounds if tractor-sprayed on small first-year chamise sprouts. Four pounds a.e. are still recommended for tractor work. However, for

helicopter spraying we increased chemical rate to 6 pounds per acre to help offset losses from drift. But we have not determined just what advantages this higher rate may have.

Volume of Chemical Application

Before 1958, spray volumes of 10 gallons per acre or less were often recommended for use on young chamise sprouts (Leonard and Harvey, 1956). Both good and poor control was obtained. A test in central California indicated that increasing spray volume, as well as chemical rate, gave greater plant kill (Plumb and Bentley, 1960). We seemed to get better penetration into the dense crowns of plants having large sprouts. Consequently, higher-than-normal spray volumes were recommended for later work. Again, we hoped to get the best kill possible with one application.

In another test, better kill was obtained by increasing volume with very low chemical rates. But increasing volume at the 4-pound chemical rate seemed to give very little advantage, and a high volume at the 8-pound rate actually gave a reduction in kill.

Timing of Application

Proper timing of a broadcast spray application has long been recognized as an important requisite for successful plant control (Leonard, 1956, 1957; Buttery, Bentley, and Plumb, 1959). The plants must be in in the proper physiological condition for chemical entry and translocation. For ideal conditions, sprouts should be growing vigorously and soil moisture should be high.

Spraying late in the growing season, usually late May or early June, has given the best control of first-year sprouts. If these plants are sprayed too early, they often resprout vigorously soon after treatment. This occurred in one test in which plants were sprayed in early May.

Older plants appeared to react in the opposite manner. A timing test on 3-year-old chamise regrowth the same year produced excellent control from spraying in early May, while spraying in June gave a poor kill.

Until some better "timing" criteria can be obtained, we will continue to recommend spraying first-year sprouts during the latter part of the growing season, but before they "harden."

Annual Growing Conditions

Physiological condition of a plant is one of the most important considerations in successful control. Consequently, growing conditions in late winter and early spring seem to seriously affect plant response to treatment later that spring. For example, growing conditions in 1958

were very different than during the following two years. Seasonal precipitation and temperature were above normal in 1958. Vigorous sprout growth occurred early and continued throughout the spring. Total plant kill on two of the three projects treated that year was rated excellent (table 1). Growing conditions were reversed in 1959. Total seasonal precipitation was about half normal. The plants grew slowly during the spring with no surge of growth typical at that time of year. A good percent of kill was obtained on only one of the initial spray jobs that year. All other projects required rebroadcast spraying. Results of spraying in 1960, another dry year, were about the same as in 1959. All new projects that year required rebroadcast spraying.

We recognize that growing conditions will vary from year to year, and that when they are poor we get less satisfactory control results. Even so, spraying must be done each year in a continuing program of brush control. With this in mind, we recommend that broadcast spraying of an area be planned for two consecutive years. If good or excellent control is obtained with one broadcast application, we are just that much ahead.

Plant Coverage

Unsatisfactory spray results can often be blamed on poor chemical coverage. Two problems arise: (a) complete misses of plants, mainly with aerial work, and (b) insufficient spray volume to penetrate a dense mass of sprouting regrowth with either aerial or ground application. Double flying each area to reduce the problem of complete misses increases the operational cost by about $1.50 per acre. However, the added cost could be justified by a better kill with one spray job.

A second way to reduce "misses" is by use of flagmen. We used them on two projects, but misses still occurred. Steep, rough terrain often makes adequate flagging impractical or even impossible. A serious safety hazard is involved. Although flagmen undoubtedly can be used to great advantage on areas of smooth terrain, their use is questionable on steep, rough terrain.

Chemical Formulation

A brush killer spray mixture of 2,4-D and 2,4,5-T is often recommended when spray conditions are not optimum, on older plants, and when hard-to-kill plants are present (Leonard, 1960). As yet, we have found no increase in kill of chamise with the addition of 2,4,5-T to the spray mix. This was concluded from tests in central California prior to 1958 on 2-year-old plants (Plumb and Bentley, 1960) and in 1959 on 1-year-old plants.

Straight 2,4-D is recommended for use on chamise regrowth. However, 1/3 to 1/2 of the "D" is usually replaced with "T," if a fairly high proportion of hard-to-kill plants are mixed in with the chamise. But we are not certain that 2,4,5-T is particularly more effective than 2,4-D for broadcast spraying in this type.

Table 1.--Fuel-break projects broadcast sprayed for control of chamise, 1958-60

Project name	Method of application	Date of application	Area in acres	Degree of control 1/	Follow-up work required
Four Corners	Tractor	April-May 1958	40	Excellent	Hand follow-up
Chocolate		May 1958	10	Poor	Broadcast respray
Oak Grove		May 1958	60	Excellent	None
Four Corners	Helicopter	May 1958	10	Excellent	Hand follow-up
Chocolate		May 1958	10	Poor	Broadcast respray
Oak Grove	Tractor	May 1959	153	Fair	Hand follow-up
Tenaja		May 1959	88	Poor	Broadcast respray
Summit		June 1959	35	Good	Hand follow-up
Wilcox		May 1959	30	Fair	Broadcast respray
Topanga		May 1959	15	Poor	Broadcast respray
Topanga	Helicopter	May 1959	10	Poor	Broadcast respray
Black Canyon	Tractor	June 1960	15	Poor	Broadcast respray
Summit		June 1960	50	Fair	
Tenaja (respray)		May-June 1960		Good	Hand follow-up
Edison	Helicopter	June 1960	60	Poor	Broadcast respray
Sitton Peak		May 1960	111	Poor	
Topanga (respray)		May 1960	25	Good	Hand follow-up
Wilcox		May 1960	100	Poor	Broadcast respray
Aqua Escondido		May 1960	30	Poor	Broadcast respray

1/ Control rating: Excellent = 99 percent plus; good = 95-98 percent; fair = 85-95 percent; poor = less than 85 percent. Based on complete plant kill.

Cost of Application

An important job is to keep an account of the actual costs of brush conversion operations on fuel-break projects, and to attempt to make the jobs more efficient. So far, our costs have been high as compared with figures commonly quoted for range improvement operations because: (a) many of the first jobs were on demonstration areas of 10-50 acres, with high costs per acre for equipment transport, mileage, crews, etc.; (b) we worked on many steep rocky sites, often poorly accessible; (c) we used heavy applications of chemical to assure positive results; and (d) we added in all costs, both direct and contributed.

Although costs were variable, tractor-boom spraying for 1958 to 1960 averaged $13 per acre with 4 pounds a.e. of 2,4-D applied in 20 gallons of emulsion. It cost $15 per acre when brushkiller was used. For helicopter spraying, 6 pounds a.e. of 2,4-D in 20 gallons of emulsion per acre with double flying, the cost was $18.50. With brushkiller it cost $21.

In the future we expect to lower the helicopter application rate to 15 gallons per acre. At this level, costs should be comparable to tractor spraying costs. Expected costs per acre for efficient broadcast spraying in chamise-chaparral, using a 15-gallon volume, are:

	Smooth terrain, tractor or helicopter, 4 pounds 2,4-D per acre	Steep, rough terrain, helicopter, 6 pounds 2,4-D per acre
Materials	$ 3.60	$ 5.40
Equipment operation	3.00	3.00
Equipment transport	2.00	2.00
Labor	1.00	1.00
Mileage	.50	.50
Miscellaneous	.50	.50
	$10.60	$12.40

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